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My testimony today is based on *Climate of Fear: Why We Shouldn't Worry about Global Warming,* which the Cato Institute published yesterday. Members of the subcommittee and other interested people will be able to find additional material on the costs and possible benefits of meeting the Kyoto agreement in my book.

As an economist, I have accepted the forecasts by the Intergovernmental Panel on Climate Changes (IPCC) of climate change that would result from continued greenhouse gas emissions under a "business-as-usual" scenario. Many of my friends in the scientific community are skeptical that warming will be as great as predicted: some contending that there is no credible scientific evidence that climate change is occurring. Certainly the satellite data fail to show that the climate is warming. Nevertheless, I have assumed that the climate would warm by 4.5" Fahrenheit by the end of the next century, the 1990 forecast of the IPCC for 2050. In its most recent reports, the IPCC has reduced its prediction to only 3.6" for the year 2100. In effect, the IPCC's best guess of temperatures is down by one-third from its 1990 prediction. Whatever warming takes place is expected to occur mainly at night and in the winter. There will be more warming towards the poles and less in tropical and semi-tropical regions.

The amount of buildup of greenhouse gases in the atmosphere is uncertain. The IPCC is forecasting that CO, levels will double by 2100. On the other hand a recent article in the *Journal of Political Economy,* a major economic journal, concluded that the

costs of solar power are declining so fast that 90 percent of the world's coal supplies will never be used. Consequently, the concentration of carbon dioxide in the atmosphere will top out sooner than expected. Any warming will be modest, will peak at the middle of the next century, and then will decline, even without carbon taxes or steps to curtail greenhouse gas emissions.'

Predicting the future, however, tends to be risky. We can have no real idea about the fuels that will be used to run our economy one hundred years from now. Americans may be running the economy on solar power or perhaps on hydrogen, or perhaps on something else. We cannot be sure. One hundred years ago, oil was considered useful only for lighting. Wood, charcoal, or coal supplied heat. The motor car had just been invented and transportation was still largely a matter of foot or horse.

Nevertheless, the Congress and the public must decide whether action to stem the emission of greenhouse gases is currently warranted. To make a rational decision, they must weigh the possible effects on Americans of continuing business-as-usual compared with the certain costs of restricting the emissions. The Congress may also want to consider the burden of acting or not acting on the rest of the world.

We have a good bit of evidence on the effects of a warmer-wetter world. As the attached charts show, the globe's climate has fluctuated greatly over time; but over the last 100 million years, it has gradually cooled (see chart 1). The last intergalcial period, about 125 thousand years ago. was considerably warmer than today (see chart 3). Since the last ice age. about 10,000 years ago, the earth has enjoyed two periods that were warmer than the present (see chart 4).

The Climatic Optimum

About 4,000 to 9.000 years ago, as chart 4 shows, the world enjoyed what historians of climate have dubbed "The Climatic Optimum." According to their best estimates, the earth was about 4" warmer than currently, a little higher than the average of the various predictions for global warming by the end of the next century. [2] Tree lines reached farther north and farther up mountains. Rain fell regularly in the Sahara desert. Plants and animals thrived and so did people. During this period many cultures shifted from the Stone Age to the Bronze Age.

Although the climate cooled a bit after 3000 **B.C.,** it stayed relatively warmer than the modem world until some time after 1000 **B.C.,** when chilly temperatures became more common. During the Climatic Optimum, Europe enjoyed mild winters and warm summers with a storm belt far to the north. Not only was the region less subject to severe storms. but the skies were less cloudy and the days, sunnier.

Notwithstanding the less stormy weather, rainfall was more than adequate to produce widespread forests. Western Europe, including parts of Iceland and the Highlands of Scotland, was mantled by great woods." The timber, until average temperatures dipped temporarily for about 400 years between 3,500 **B.C.** and 3,000 **B.C.,** consisted of warmth-demanding trees, such as elms and linden in North America and oak and hazel in Europe. Those species have never regained their once dominant position in Europe and America. Not only did Europe enjoy a benign climate with adequate rainfall; but the Mediterranean littoral. including the Middle East. apparently received considerably more moisture than it does today.' The Indian subcontinent and China were also much wetter during this period.'

Compared to the cooler periods in the last few thousand years, the Sahara was much wetter and more fertile during the Climatic Optimum." Cave paintings from the epoch depict hippopotamuses, elephants, crocodiles. antelopes, and even canoes.[7] The water level in Lake Chad, about 14" north of the equator in central Africa, was some 30 to 40 meters. that is, 90 to 125 feet higher, than it is today. indicating much greater precipitation. Ruins of ancient irrigation channels in Arabia, probably from the warmest millennia, indicate that they derived their water from sources well above current water supplies, attesting to a wetter climate. 'With the cooling that started after 3000 **B.C.,** North Africa dried up and the abundance of life disappeared.

In Europe, the Climatic Optimum led to an expansion of civilization, as witnessed by the construction of cities and a technological revolution. The Bronze Age replaced the New Stone Age." The more benign climate with less severe storms encouraged travel by sea.

During this warm period, trade flourished. People from ancient Denmark shipped amber along the Atlantic coast to the Mediterranean. As early as 2000 **B.C.,** the Celts were

apparently sailing from Cornwall and Brittany to both Scandinavia and southern Italy. Astrological monuments built around this time, such as Stonehenge, indicate that the skies were less cloudy than now." The glaciers in the Alps during the late Bronze Age were only about 20 percent of the size of the ice in the nineteenth century, and merchants made their way through the Brenner Pass. the dominant link between northern and southern Europe. Northern Europeans exchanged tin for manufactured bronze from the south. Alpine peoples mined gold and traded it for goods crafted around the Mediterranean. Baltic amber even found its way to Scotland.

During the warm period prior to 3000 **B.C.,** China experienced much warmer temperatures. Midwinters, in particular, were as much as 9" hotter and rice was planted a month earlier than is now common." Bamboo, valued for food, building material, writing implements, furniture, and musical instruments, grew much farther north — about 3" in latitude — than is now possible." Chinese archaeologists have found evidence in a district near Sian that the climate 5,000 to 6.000 years ago was warmer and wetter than the present.

Prior to 2500 to 1750 **B.C.,** northwestern India, which is now very dry, enjoyed greater rainfall than it does in the twentieth century.[13] In the Indus Valley, the Harappas created a thriving civilization that reached its apogee during the warmest and wettest periods, when their farmers were growing cereals in what is now a desert."[14] The area was well watered with many lakes. That civilization disappeared around 1500 **B.C.** at a time when the climate became distinctly drier.[15]

The Little Climatic Optimum

From around **A.D. 800** to 1200 or 1300, the globe again warmed considerably and civilization prospered. This Little Climatic Optimum generally displays many of the same characteristics as the first Climatic Optimum (see chart 5).[16] Virtually all of northern Europe, the British Isles, Scandinavia, Greenland, and Iceland were considerably warmer than at present. The Mediterranean, the Near East, and North Africa, including the Sahara, received more rainfall than they do today." North America enjoyed better weather during most of that period. In the early part of this epoch, China experienced

higher temperatures and a milder climate. From western Europe to China, East Asia, India, and the Americas, mankind flourished as never before.

The timing of the medieval warm spell, which lasted no more than 300 years, was not synchronous around the globe. For much of North America, for Greenland, and in Russia, the climate was warmer between 950 and 1200.[18] The warmest period in Europe appears to have come later, roughly between 1150 and 1300, although parts of the tenth century were quite warm. Evidence from New Zealand indicates peak temperatures from 1200 to 1400. Data on the Far East is meager but mixed. Judging from the number of severe winters reported in China, the climate was somewhat warmer than normal in the ninth, tenth, and eleventh centuries, colder in the twelfth and thirteenth, and very cold in the fourteenth. Chinese scholar Chu Ko-then reports that the eighth and ninth centuries were warmer and received more rainfall but that the climate deteriorated significantly in the twelfth century.[19]

Europe

The warm period coincided with an upsurge of population almost everywhere, but numbers are available only for Europe. For centuries during the cold damp Dark Ages, the population of Europe had been relatively stagnant. Towns had dwindled to a few houses clustered behind city walls. In Europe after the climate improved, cities grew in size: new towns were founded: and colonists moved into relatively unpopulated areas.

With a more pleasant climate. people spent longer periods outdoors: food supplies were more reliable. Even the homes of the peasants would have become warmer and less damp. The draining or drying up of marshes and wetlands reduced the breeding grounds for mosquitoes that brought malaria. Overall the infant and childhood mortality rate must have fallen. spawning an explosion in population.

The twelfth and thirteenth centuries witnessed a profound revolution which, by the end of the thirteenth century. had transformed the landscape into an economy filled with merchants, vibrant towns, and great fairs. Crop failures became less frequent; new territories were brought under control. With a milder climate and a more reliable food supply, the population mushroomed.[20]

The warmth of the Little Climatic Optimum made territory farther north cultivable. In Scandinavia, Iceland, Scotland, and the high country of England and Wales, farming became common in regions that neither before nor since have yielded crops reliably. In Iceland, oats and barley were cultivated. Scotland flourished during this warm period with increased prosperity and construction." In Norway, farmers were planting farther north and higher up hillsides than at any time for centuries. Greater crop production meant that more people could be fed, and the population of Scandinavia exploded.[22] The rapid growth in numbers in turn propelled and sustained the Viking explorations and led to the foundation of colonies in Iceland and Greenland. Greenland savored weather that was 4" to 7" warmer than at present: settlers could bury their dead in ground that is now permanently frozen.

The increasingly warm climate was reflected in a rising sea level. People were driven out of the lowlands and there was a large-scale migration of men and women from those areas to places east of the Elbe, into Wales, Ireland, and Scotland. Flemish dikes to hold back the sea date at least from the early eleventh century.

In addition to the land north of the Alps, the warmer, rainier climate benefited southern Europe, especially Greece. Sicily, and southern Italy. All of the *Mezzogiorno* in the Middle Ages did well." Christian and Muslim lands achieved great brilliance. Cordova. Palermo, Constantinople, and Cairo all thrived, engendering great tolerance for contending religions." Christian communities survived and prospered in Muslim Cairo and Cordova.

In A *History of Knowledge,* Charles Van Doren contends that "the . . . three centuries from about 1000 to about 1300 became one of the most optimistic. prosperous, and progressive periods in European history."[25] All across Europe, the population went on an unparalleled building spree, erecting at huge cost spectacular cathedrals and public edifices. Byzantine churches gave way to Romanesque, to be replaced in the twelfth century by Gothic cathedrals. During this period construction began on the Abbey of Mont-St-Michel (1017), St. Mark in Venice (1043), Westminster Abbey in London (1045). the Cathedral of our Lady in Coutances (1056), the Leaning Tower at Pisa (1067), the Cathedral of Santiago de Compostela in northern Spain (1078), the Cathedral

of Modena (1099), Vézélay Abbey in France (1130), Notre-Dame in Paris (1163), Canterbury in England (1175), Chartres (1194), Rouen's cathedral in France (1201), Burgos's cathedral in Castile (1220), the basilica of Saint Francis in Assisi (1228), the Sainte Chapelle in Paris (1246), Cologne Cathedral (1248), and the Duomo in Florence (1298).

Virtually all the magnificent religious edifices that we visit in awe today were started by the optimistic populations of the eleventh through the thirteenth centuries, although many were not finished for centuries. In southern Spain, the Moors laid the cornerstone in 1248 for perhaps the world's most beautiful fortress, the Alhambra. In the middle of the thirteenth century, as well, the Franks founded a fort, Mistra, near ancient Sparta, which later became a Byzantine city known for its art and culture.

Economic activity blossomed throughout the continent. Banking, insurance, and finance developed; a money economy became well established; manufacturing of textiles expanded to levels never seen before. Farmers were clearing forests, draining swamps, and expanding food production to new areas.[26] In England, virtually all the churches and chapels that had originally been built of wood were reconstructed in stone between the twelfth and fourteenth centuries."

Starting in the eleventh century, European traders developed great fairs that brought together merchants from all over Europe. At their peak in the thirteenth century, they were located on all the main trade routes and not only served to facilitate the buying and selling of all types of goods but functioned as major money markets and clearinghouses for financial transactions. The fourteenth century saw the waning of those enterprises, probably because the weather became so unreliable and poor that transport to and from those locations with great stocks of goods became impractical.

During the High Middle Ages of the twelfth and thirteenth centuries, technology grew rapidly. New techniques expanded the use of the water mill, the windmill, and coal for energy and heat. Sailing improved through the invention of the lateen sail, the sternpost rudder, and the compass. Governments constructed roads and contractors developed new techniques for the use of stone in construction. New iron casting techniques led to better tools and weapons. The textile industry began employing wool,

linen, cotton, and silk and, in the thirteenth century, developed the spinning wheel. Soap, essential for hygiene, came into use in the twelfth century. After the tenth century, mining, which had declined since the Romans, at least partly because the cold and snow made access to mountain areas difficult, revived.

Farmers and peasants in medieval England launched a thriving wine industry south of Manchester. Good wines demand warm springs free of frosts, substantial summer warmth and sunshine without too much rain, and sunny days in the fall. Winters cannot be too cold — not below zero Fahrenheit for any significant period. The northern limit for grapes during the Middle Ages was about 300 miles above the current commercial wine areas in France and Germany. These wines were not simply marginal supplies but of sufficient quality and quantity that, after the Norman Conquest, the French monarchy tried to prohibit British wine production.[28]

Europe's riches and a surplus of labor enabled and emboldened its rulers to take on the conquest of the Holy Land through a series of Crusades starting in 1096 and ending in 1291. The Crusades were stimulated at least in part by a mushrooming population and an economic surplus large enough to spare men to invade the Muslim empire. A major attraction of the First Crusade was the promise of land in a "southern climate."[29]

The Arctic

From the ninth through the thirteenth centuries, agriculture spread into northern Europe and Russia where it had been too cold to produce food before. In the Far East, Chinese and Japanese farmers migrated north into Manchuria, the Amur Valley, and northern Japan." As mentioned above, the Vikings founded colonies in Iceland and Greenland, a region that may have been greener than historians have claimed. It was also during this period that Scandinavian seafarers discovered "Vinland" — somewhere along the east coast of North America. The subsequent Mini Ice Age cut off the colonies in Greenland from Europe, and they eventually died out.

The Eskimo population apparently expanded throughout the Arctic area during the medieval warm epoch."' Starting with Ellesmere Land around A.D. 900, Eskimo bands and their culture spread from the Bering Sea into the Siberian Arctic. Two centuries later,

these people migrated along the coast of Alaska and into Greenland. During this period the Eskimos' main source of food came from whaling, which had to be abandoned with the subsequent cooling.

The Far East

As noted above, the warming in the Far East seems to have preceded that in Europe by about two centuries. Chinese economist Kang Chao has studied the economic performance of China since 200 B.C. In his careful investigation, he discovers that real earnings rose from the Han period (206 B.C. to A.D. 220) to a peak during the Northern Sung Dynasty (A.D. 961 to 1127).[32] This coincides with other evidence of longer growing seasons and a warmer climate. Chao reports that the number of major floods averaged fewer than four per century in the warm period of the ninth through the eleventh centuries while the average number was more than double that figure in the fourteenth through the seventeenth centuries of the Mini Ice Age.[33] Not only floods but droughts were less common during the warm period. The era of benign climate sustained about three major droughts per century, while during the later cold period, China suffered from about thirteen each hundred years.

The wealth of this period gave rise to a great flowering of art, writing, and science. The Little Climatic Optimum witnessed the highest rate of technological advance in Chinese history. During the 300 years of the Sung Dynasty, farmers invented 35 major agricultural implements — that is, over 11 per century, a significantly higher rate of invention than in any other era.[34] In the middle of the eleventh century, the Chinese became the first to employ movable type."

During the Northern Sung Dynasty Chinese landscape painting with its exquisite detail and color reached its apogee.[36] Adam Kessler, curator of the Los Angeles County Museum of Natural History, dates the earliest Chinese blue-and-white porcelain to the twelfth century." The Southern Sung produced pottery and porcelains unequaled in subtlety and sophistication. Literature, history, and scholarship flourished as well. Scholars prepared two great encyclopedias, compiled a history of China, and composed essays and poems. Mathematicians developed the properties of the circle. Astronomers

devised a number of technological improvements to increase the accuracy of measuring the stars and the year.[38]

Japan also prospered during the Little Climatic Optimum. In the Heian Period (A.D. 794 to 1192), the arts thrived as emperors and empresses commissioned vast numbers of Buddhist temples. Murasaki Shikibu, perhaps the world's first female novelist, composed Japan's most famous book, *The Tale of Genji.* Other classical writers penned essays: Sei Shonagon, another lady of the court, wrote *Makura-no-Soshi* (the Pillow Book). The Japanese aristocracy vied in composing the best poems. All of this reveals a prosperous economy with ample food stocks to support a leisured and cultivated upper class.

Over the four hundred years between A.D. 800 and 1200, the peoples of the Indian subcontinent prospered as well. Society was rich enough to produce colossal and impressive temples. beautiful sculpture, and elaborate carvings, many of which survive to this day.'" The Lingaraja Temple, one of the finest Hindu shrines, as well as the Shiva Temple. date from this period."' Seafaring empires existed in Java and Sumatra, which reached its height around 1180. Ninth-century Java erected the vast stupa of Borobudur; other temples — the Medut, Pawon, Kelasan, and Prambanan — originate in this era. In the early tuelfth century, the Khmers, predecessors of the Cambodians, built the magnificent temple of Angkor Wat.[41] In the eleventh century, Burmese civilization reached a pinnacle. In or around its capital, Pagan, between 931 and 1284, succeeding kings competed in constructing vast numbers of sacred monuments and even a library." Today the area is a dusty plain littered with the crumbling remains of about 13,000 temples and pagodas built in a more hospitable era.

Archaeologists studying the compositions of forests in New Zealand have found that the South Island enjoyed a warmer climate between A.D. 700 and 1400, about the time that Polynesians were colonizing the South Pacific Islands and the Maoris were settling in New Zealand."

The Americas

Less is known about civilizations in the Americas during the Little Climatic Optimum or even how the prevailing weather changed. Much of the currently arid areas

of North America, however, were apparently wetter during this epoch. The Great Plains east of the Rocky Mountains, the upper Mississippi Valley, and the Southwest received more rainfall between A.D. 800 and 1200 than they do now.[44] Radiocarbon dating of tree rings indicates that warmth extended from New Mexico to northern Canada. In Canada. forests extended about sixty miles north of their current limit.[45]

Starting around A.D. 800 to 900, the indigenous peoples of North America extended their agriculture northward up the Mississippi, Missouri, and Illinois river basins. By 1000 they were farming in southwestern and western Wisconsin and eastern Minnesota.[46] They grew corn in northwestern Iowa prior to 1200 in an area that is now marginal for rainfall.[47] When colder, drier weather set in after 1150 to 1200, Indian settlements on the northern plains of Iowa were abandoned. After that time, the natives substituted bison hunting for growing crops. In general, the land east of the Rocky Mountains enjoyed wetter conditions from 700 to 1200 and then turned drier as colder Arctic weather intruded more frequently.

The Anasazi civilization of Mesa Verde flourished during the warm period; but the cooling of the climate around 1280, at the end of the medieval warmth, probably led to its disappearance.* That climatic shift brought drier conditions to much of the region, leading to a retreat from the territory and forcing the Pueblo Indians to shift their farming to the edge of the Rio Grande River.

Around 900, the Chimu Indians in South America developed an extensive irrigation system on Peru's coast to feed their capital of between 100,000 to 200,000 souls, a huge number for the era.[49] The Toltec civilization, which occupied much of Mexico, reached its apogee in the thirteenth century.[50] By 1200, the Aztecs had built the pyramid of Quetzalcoatl near modem Mexico City.[51] The Mayas' civilization, however, reached a peak somewhat earlier, before 1000, and declined subsequently for reasons that remain unclear. It is possible that the warming after 1000 led to additional rainfall in the Yucatan, making the jungle too vigorous to restrain and causing a decline in farming while at the same time improving agricultural conditions in the Mexican highlands and farther north into what is now the southwestern United States.

Thus warmer times brought benefits to most people and most regions, but not all. As is always the case with a climatic shift, the changes benefited some while affecting other adversely. Change is disruptive; at the same time, it produces new ideas and new ways of coping with the world. Nevertheless, for most of the known globe, the Little Climatic Optimum of the ninth through the thirteenth centuries brought significant benefits to the local populations. Compared with the subsequent cooling, it was nirvana.

The Mini Ice Age

The Little Ice Age is even less well defined than the medieval warm period. Climatologists are generally agreed that, at least for Europe, North America, New Zealand, and Greenland, temperatures fell, although with many ups and downs, after 1300 to around 1800 or 1850, when they began to rebound. There was a cold period in the first decade of the fourteenth century. another around 1430, and yet another in 1560. The end of this period of increasingly harsh temperatures could have been as early as 1700. around 1850. or even as late as 1900 for Tasmania. The worst period for most of the world occurred between 1550 and 1700." One reasonable interpretation of the data is that the world has been cooling since around 4500 B.C., with a temporary upswing during the High Middle Ages.

Europe and Asia cooled substantially from around 1300 to 1850, especially after 1400. with temperatures falling some 2" to 4" below those of the twentieth century. This indicates that temperatures may have dipped by as much as 9" in the two hundred years from 1200 to 1400. a drop of about the same magnitude as the maximum rise forecast from a doubling of CO?. Those frigid times did bring hardships; and, as reported above, world population growth slowed. For much of these centuries, famine and disease stalked Europe and Asia.

The Mini Ice Age, especially the century and a half between 1550 and 1700 — the exact timing varied around the globe — produced low temperatures throughout the year, as well as considerable variation in weather from year to year and from decade to decade. It included some years that were exceptionally warm.[53] The polar cap expanded, as did the circumpolar vortex, driving storms and cold weather to lower latitudes, Although much of Europe experienced greater wetness than during the earlier warm

epoch, it was more the product of less evaporation because of the cold than of excessive precipitation.

The expansion of the circumpolar vortex produced some of the greatest windstorms ever recorded in Europe and, not so incidentally, changed history. A terrible tempest destroyed the Spanish Armada in 1588. Fierce gales wracked Europe in December 1703 and on Christmas Day 1717.[54] The contrast between the cold northern temperatures that moved south and the warm subtropical Atlantic undoubtedly generated a fierce jet stream.

As early as 1250, floating ice from the East Greenland Ice Cap was hindering navigation between Iceland and Greenland." Over the next century and a half, the prevalence of icebergs became worse; and by 1410 sea travel between the two outposts of Scandinavia ceased. For about 350 years, from the third quarter of the fifteenth century to 1822, no ships found their way to Greenland and the local population perished.[56]

Harvest failures in the last quarter of the thirteenth century heralded the deteriorating climate in Europe. Compounding the insufficiency was a shift of land from farming. made riskier by the change in climate, to enclosure and sheep rearing.[57] Average yields. already low by modern standards. worsened after the middle of the thirteenth century.[58] One of the first severe bouts of cold, wet weather afflicted Europe from 13 10 to 13 19, leading to large-scale crop failures.[59] Food supplies deteriorated sharply, generating famine for much of Europe in 1315-18 and again in 1321.[60] Harvest deficits and hunger preceded the Black Death by 40 years.[61] For much of the continent, "the poor were reduced to eating dogs, cats and even children."[62] This scanty food output contributed to a decline in population that was aggravated by disease. The history of many villages shows that they were abandoned before, not after, the beginning of the plague. By 1327, the population in parts of England — especially those later devastated by the plague — had fallen by 67 percent.[63] People poorly nourished were quickly carried off by disease. Between 1693 and 1700 in Scotland, seven out of the eight harvests failed and a larger percentage of the population starved than died in the Black Death of 1348-50.[64]

In two terrible years, 1347 and 1348, famine struck northern Italy, followed by the Black Death, which decimated most of the populace not already dead from lack of food.[65]

Bubonic plague spread across the Alps after 1348, killing in the next two years about one-third of northern Europe's people. Life expectancy fell by ten years in a little over a century, from 48 years in 1280 to 38 years in the years 1376 to 1400.[66] Crops often failed; peasants abandoned many lands that they had cultivated during the earlier warm epoch. Between 1300 and 1600, the growing season shrank by three to five weeks with a catastrophic impact on farming.[67] In Norway and Scotland, the population declined and villagers deserted many locales well before the plague reached those areas.[68] The capitals of both Scotland and Norway moved south before both areas lost their autonomy.

The cooling after 1300 probably contributed significantly to the virulence of the bubonic plague, the greatest disaster ever to befall Europe. By 1348 rodents carrying fleas infested with bubonic plague had marched or been carried from the Crimea into Europe. Historians have estimated that as many as one-third of all the people in Europe died in the raging epidemic that swept the continent.[69] This outburst of the plague, like a similar one in the sixth century, occurred during a period of increasing coolness, storminess, and wet periods, followed by dry hot ones. The unpleasant weather is likely to have confined people to their homes, where they were more likely to be exposed to the fleas that carried the disease. In addition. the inclement weather may have induced rats to take shelter in human buildings, exposing their inhabitants to the bacillus.

The end of the medieval warmth had devastating effects on populations that lived at the edge of habitable lands. Historians, for example, have estimated the population of Iceland in the last decades of the eleventh century at about 77,000; early in the fourteenth, it still numbered over 72,000. By 1800, after several hundred years of coolness and stormy weather, the poor conditions had more than halved the number of Icelanders to 38,000.[70]

The terrible climate in Europe after the thirteenth century brought a halt to the economic boom of the High Middle Ages. Innovation slowed sharply.[71] For the next 150 years, except for military advances, technological improvements ceased. Population growth not only ended but, with starvation and the Black Death, fell. Without the drive of additional numbers of people, colonial enterprise ceased and no new lands were reclaimed or towns founded. The economic slump of 1337 brought on the collapse of the

great Italian bank, Scali, leading to one of the first recorded major financial crises." Construction on churches and cathedrals halted.

The Mini Ice Age at its coldest devastated the fishing industry. From 1570 to 1640, during the most severe period, Icelandic documents record an exceptionally high number of weeks with coastal sea ice. Between 1615 to 1828, with the exception of a few years, fishermen from the Faeroe Islands suffered from a lack of cod, which need water warmer than 36" Fahrenheit to flourish. During the worst period, 1685 to 1704, fishing off southwest Iceland failed totally.[73] In the very icy year of 1695, Norwegian fishermen found no cod off their coast.

The Modern World

Clearly climate is far from the only influence on man's well being. Governments that extort too much from their people impoverish their countries. A free and open economy stimulates growth and prosperity. War and diseases can prove catastrophic. At the same time. a change in climate has frequently been a cause of war or aided the spread of disease. A shift to more arid conditions. for example, impelled the Mongols to desert their traditional lands to invade richer areas. A cold. wet climate can also confine people to close quarters, abetting contagion. Moreover, a shift toward a poorer climate can lead to hunger and famine, making disease more virulent.

With the growth in wealth and resources, the influence of climate on human activities has declined. Primitive man and hunter-gatherer tribes were at the mercy of the weather, as are societies that are still bound almost totally to the soil. A series of bad years could be devastating. If, as was the usual case until very recently, transportation is costly and slow. even a regionalized drought or an excess of rain in one area can lead to disaster, even though crops may be plentiful a short distance au-ay. Thus variation in the weather for early man had a more profound influence on his life and death than do fluctuations in temperature or rainfall in modern times when economies are more developed. Because of modem transportation, even poor agricultural states today are less at the mercy of weather than were such people in earlier centuries. Since the advent of the Industrial Revolution, climate has basically been confined to a minor role in human activity.

The Economic Costs (Benefits?) of a Warmer World

Casual analysis of the economic effects of climate change demonstrates that most modern industries are relatively immune to weather. Climate affects principally agriculture, forestry, and fishing, which together constitute less than two percent of U.S. GDP. Manufacturing, most service industries, and nearly all extractive industries remain unaffected by climate shifts. Factories can be built in northern Sweden or Canada or in Texas, Central America, or Mexico. Higher temperatures will leave mining largely untouched; oil drilling in the northern seas and mining in the mountains might even benefit. Banking, insurance, medical services, retailing, education, and many other services can prosper as well in warm climates (with air-conditioning) as in cold (with central heating). Fuel consumption for heating will decline while that for air-conditioning will increase. Transportation will benefit generally from a warmer climate since highway transport would suffer less from ice and snow. Air travel would be subject to fewer weather-related delays: air transport costs, which are higher in cold weather, would be reduced. Bad weather in the summer has fewer disruptive effects and passes quickly: fewer storms and less fog will make shipping less risky. Construction would experience fewer holdups from weather.

Inhabitants of the advanced industrial countries would scarcely notice a rise in worldwide temperatures. As modem societies have developed a larger industrial base and become more service oriented, they have grown less dependent on farming, thus boosting their immunity to the vagaries of the weather. A few services, such as tourism, may be susceptible to temperature or precipitation changes: a warmer climate would be likely to shift the nature and location of pleasure trips. Skiers might have to go farther north or higher up the mountains to find reliable snow; the season could be shortened. Since ski resorts often suffer more from lack of snow than from weather that is too warm, increased participation may partially offset earlier springs and later falls. Nevertheless, as a skier I am unhappy with the thought that good snow may be found only farther north or at higher elevations. Most Americans who enjoy outdoor sports, however, do so in the summer. Golfers, hikers, backpackers, canoers, or just picnickers will be able to delight in their

favorite outdoor activity during more of the year. White water rafters will also have the bonus of greater stream flows resulting from more rainfall.

Warmer conditions might also mean that fewer northerners would feel the need to vacation in Florida or the Caribbean. On the other hand, new tourist opportunities might develop in Alaska, northern Canada, and other locales at higher latitudes or upper elevations.

Agriculture

Food output depends largely on agriculture, an industry that would be particularly sensitive to any climate change. Water availability, soil composition, technology, sunshine, and temperature all affect crop production. Warm climates have longer growing seasons and higher productivity. Wetter areas, holding other factors constant, are more productive than dry, unless the latter are irrigated. Climate change, if it takes place, is most likely to lead to a warmer climate, especially in higher latitudes where it will have a strong beneficial effect on the length of the growing season. Climatologists predict that a warmer world would enjoy more rainfall. Although models are unable to forecast where rainfall will increase, most places should experience at least a little more. The net result of warming and enhanced precipitation would be to boost farm output.

In addition, carbon dioxide is an essential ingredient for plant growth and its concentration in the atmosphere is rising. This gas boosts photosynthetic capacity and also water-use efficiency. According to peer-reviewed research, a doubling of carbon dioxide would on average boost growth by 52 percent." At the same time, the improved water-use capacity of plants will mean that less rainfall would be needed to grow crops, thereby economizing on irrigation and perhaps offsetting partially any local reduction in rainfall.'" As a consequence, a boost in carbon dioxide would have a strong beneficial effect on food production.

Evidence exists that rising levels of CO, have already boosted plant growth worldwide. Tests at Mauna Loa in Hawaii have not only documented a rise in the level of carbon dioxide in the atmosphere, from 3 16 parts per million in 1959 to 360 ppm in 1996, but have shown a marked seasonal pattern which has become more pronounced.[76] The levels of CO, in the atmosphere begin to fall in the northern spring as the new growth of

plants absorbs the gas and reach a low by early fall. As plant growth ceases and leaves fall in autumn. CO_2 levels rebound to a mid-winter high. The amplitude of this pattern has been increasing, at least since 1960, by about 0.5 percent annually.[77] This would suggest that plant growth worldwide has been on the upswing.

Additional evidence that agricultural has benefited comes from Dr. Ranga B. Myneni, a biologist at Boston University, and his colleagues who have found that, since 1980, plant growth, during the summer months. has become more vigorous north of the 45th parallel.[78] Inasmuch as there has been no measurable warming over this period— some areas have warmed while others have not — the result must stem from increased CO, concentrations. They report that the growing season has lengthened by 12 days and that plant growth has become 10 percent more energetic. Similar reports have come from Australia where researchers have discovered that warmer weather, more rainfall, and perhaps greater CO, have led to bumper crops."

In 199-f two scientists, Paul Knapp and Peter Soulé, compared a site in central Oregon that had been extensively surveyed in 1960 with its flora fourteen years later. The region was almost inaccessible: climate had remained constant; human activity, given its remoteness, was negligible. They reported that the site had become much greener, with large increases in trees, perennial grasses, and western juniper. After systematically excluding all other factors. they- concluded that the rise in CO, had boosted growth."

Many studies have examined the relationship between warming and agricultural output. In a cautious report. the United States Department of Agriculture reviewed the likely influence of global warming on crop production and world food prices. The study, assumed that farmers failed to make any adjustment to mitigate the effects of warmer, wetter, or drier weather — such as substituting new varieties or alternative crops and increasing or decreasing irrigation, Nor did it include the fertilizing effect of CO,. Thus it underestimated the increase in crop yields that would result from continued increases in greenhouse gas emissions. Nevertheless, the authors conclude:

> The overall effect on the world and domestic economies would be small as reduced production in some areas would be balanced by gains in others, according to an economic model of the effects of climate change on world agricultural markets. The model . . . estimates *a slight increase* in world output and a *decline*

in commodity prices under moderate climate change conditions.[81] [Emphasis added]

Economists Robert Mendelsohn. William Nordhaus, and Daigee Shaw researched the relationship between climate and land values in the United States.[82] After holding land quality, the proximity to urban areas and the nearest coast, and income per capita constant, they found that climate explained over two-thirds of the value of crop lands. They concluded that, for the lower 48 states, a rise in average temperature of about 5°F and an 8 percent increase in rainfall stemming from global warming would, depending on the model used, reduce the value of output between 4 and 6 percent or boost the value of output slightly. This result ignores the effect of increased CO_2 on farm output and thus understates the rise in agricultural product.

Forests

Forestry is another sector subject to change as a result of an increase in CO, and world temperatures. Canadian agricultural economists, examining the effect of warming and a doubling of CO_2 on forestry production, concluded that increased carbon dioxide would boost productivity by 20 percent and that overall the harvest of timber in Canada would climb by about 7.5 percent.[83] Although their research applies only to our northern neighbor. it seems reasonable to infer that timber output in the United States could be more than maintained at current levels. If the climate changes, forest managers can shift to types of trees that fit the new environment.

Brent Sohngen of Ohio State University and Robert Mendelsohn of Yale School of Forestry and Environmental Studies have estimated that the U.S. timber market would benefit from climate change from less than 1 percent to more than 10 percent of the current value of American forests.[84] British researcher J. L. Innes of the Forestry Commission in Surrey, UK, reports that, over the last 100 years, forests have expanded "in areas as far apart as southern Patagonia and northern Finland. As growth . . . is primarily controlled by temperature, it seems likely that climatic change is involved."[85] The IPCC has projected that global forest area could increase as much as 9 percent.[86]

Species Extinction

Some species, we don't know how many or which, may find that changes in the weather make it too difficult for them to reproduce and survive. Although extinction is always distressing, paleontologists estimate that perhaps 99 percent of all species that have ever flourished are no longer in existence. Far from being a catastrophic event, the loss of a species is quite normal. Some environmentalists claim that we are losing species at unprecedented rates: but, given the really catastrophic decimation 65 million years ago when a six and a half mile wide comet wiped out from 60 to 75 percent of all species on the planet, including the dinosaurs, the current losses seem insignificant.

Of the 1354 endangered species listed since 1966 by the Department of Interior, only one-half of one percent have become extinct. Although those plants and animals listed do not necessarily represent a random sample of all living beings, they are presumably some of the most visible of those threatened and thus would be expected to have a higher mortality rate than non-listed species. That they have suffered so few casualties over the last 30 years scarcely indicates a wholesale loss of species.

A wetter, warmer climate should be conducive to the evolution of additional species. Tropical areas teem with more different animals and plants than are native to temperate climates. For example, Lake Malawi in East Central Africa is home to more than 500 different species of fish, most of which are unique to that lake. [87] The Great Lakes, which are nearly nine times the size of Lake Malawi, contain only 173 different types of fish. In addition. the proliferation of plants, stemming from an atmosphere enriched with carbon dioxide, would provide more and better fodder for animals. Almost all species should benefit.

A number of environmentalists have argued that all species are valuable since any one might be the source of a chemical substance that could cure cancer, stop infections, or ease pain. Given the number of closely related species that manufacture many of the same types of compounds. given the number of synthetic drugs and current pharmaceuticals which may produce similar therapeutic effects, and given the cost of finding, testing, and marketing any new chemical produced by a single species,

economists have concluded that the value of such a plant or animal in the wild is virtually nil.[88]

Sea Level Rise

The IPCC concludes that a 4.5" warmer world would lift sea levels by six inches to three feet, with the central estimate being about one and a half feet by the year 2100.[89] Rising sea levels would, of course, impose costs on low-lying regions, including a number of islands and delta areas. For the United States — assuming a three-foot rise in sea level, at the high end of predictions for the year 2100 — economists have estimated the costs of building dikes and levees and of the loss of land at $7 to $10.6 billion annually, or less than 0.2 percent of GDP.[90] For some small island nations, of course, the problems could be much more severe and their hardships should be addressed.

Heating and Cooling Expenses

Warming will reduce the costs of home and office heating while increasing the expense of air-conditioning. The Department of Energy has estimated that even with higher outlays for the cooling, a warming of 4.5°F would bring net savings for Americans of $12.2 billion."

Human Amenities

Do people prefer the summer or the winter? Do humans enjoy warm weather or cold? What proportion of vacationers in the winter go south and what proportion go to ski resorts? The answer is obvious: people call warm weather "clement" and enjoy warm, sunny days. When people retire, they often move south. According to a 1966 survey of Americans turning 50 in 1996, almost 40 percent planned to move when they retired and the most important criterion in selecting their destination (40 percent) was a "more favorable climate."[92] People retire to Florida, not Minnesota.

The difference in average temperatures between New York and Atlanta is actually greater than the rise forecast for the end of the next century. In spite of or because of the hotter climate in Georgia, millions of New Yorkers have moved south, perhaps to root for the Braves, but more likely to escape the ice and snows of the Empire State. Doctors have

been known to recommend that their patients move for their health and Duluth is not usually what they have in mind.

In my research, which will appear shortly in *Economic Inquiry,* I investigated the wages workers were willing to forego in order to enjoy a more clement climate. The result implies that, depending on the particular model, the gain from a warmer climate could be as little as $30 billion or as much as $100 billion.[93]

Mortality and Morbidity

The historical evidence shows that warmer weather has typically brought longer lives and a spurt in population. Colder weather has reduced health and devastated human beings. Nevertheless, many researchers, environmentalists. and politicians are forecasting that rising world temperatures in the next century will have devastating effects on human health.[94] Referring to the world as a whole, Working Group II of the Intergovernmental Panel on Climate Change asserted that "climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life."[95] The authors of the IPCC report feared that increases in heat waves would cause a rise in deaths from cardio-respiratory complications. They also foresaw a rise in vector-borne diseases, such as malaria and dengue and yellow fevers. The report did acknowledge briefly that, in colder regions. there would be fewer such deaths.

Most of the causes of premature death have nothing to do with climate. Worldwide the leading causes are chronic diseases — accounting for 24 million deaths in 1996 — such as maladies of the circulatory system, cancers. mental disorders, chronic respiratory conditions, and musculoskeletal disorders, none of which has anything to do with climate but everything to do with aging.%' Another 17 million, most of them in poor countries, succumbed in the same year to disorders caused by infections or parasites, such as diarrhea. tuberculosis, measles, and malaria. Many of those diseases are unrelated to climate; most have to do with poverty.

Diarrhoeal diseases, such as cholera and dysentery, killed 2.5 million people out of the 52 million who died worldwide in 19%. Through the provision of fresh water and proper sanitation, those diseases are easily preventable. Although a warmer climate might make the environment more hospitable for such afflictions as cholera, dysentery, and

typhoid, in areas without good sanitation or clean water, chlorination and filtration could halt their spread.

Both the scientific community and the medical establishment maintain that the frightful forecasts of an upsurge in disease and early mortality stemming from climate change are unfounded, exaggerated, or misleading and do not require action to reduce greenhouse gas emissions. Science magazine reported that "predictions that global warming will spark epidemics have little basis, say infectious-disease specialists, who argue that public health measures will inevitably outweigh effects of climate."[97] It added, "Many of the researchers behind the dire predictions concede that the scenarios are speculative."

The American Council on Science and Health, a well-known health policy institute. has emphasized that limiting greenhouse gas emissions "would not be prudent. Fossil-fuel combustion ... is vital to high-yield agriculture and other practices that are fundamental to the well-being of the human population."[98] Its statement maintains: "The optimal approach to dealing with prospect of climate change would . . . include improvement of health infrastructures (especially in developing countries)." The Council lists improvements in emergency responses to extreme weather events; intensive cost-effective control of insect vectors, especially in developing countries; improvement in drinking water and sanitation in developing areas as measures that should be carried out regardless of whether the global climate changes. The ACSH rejects specifically measures that "would impair economies and limit public-health resources."

In a forthcoming study I estimate that a warmer climate would reduce deaths by about 40.000 annually. If the lives saved reflect a random sample of the U.S. population, their value would be somewhere between $2 million and $10 million per life saved or between $30 billion and $1 trillion.* To be conservative and because most of the reduced numbers of deaths probably involve the very elderly, Table 1, below, values those lives at only $1 million each.

Not only should warmer weather extend lives, it should also reduce illnesses. A conservative estimate of the gain reflects simply the wage cost to people with jobs who are not at work because of illness. This neglects the gain to those not in the paid work

force and those who come to work even though they have a cold or the flu. 1 assume that a 4.5” warmer temperature would reduce illness by the same amount that it would reduce deaths (1.8 percent). Worker’s compensation consequently would fall by the same percentage, producing savings of around three-quarters of a billion dollars.[100]

Overall Effects of Climate Change

Table 1 presents my estimates of the benefits and costs of global warming for Americans. Even though many potential advantages have not been included, the public would benefit by over $100 billion per year or roughly 1 percent of GDP. It seems almost indisputable that Americans would be better off at the end of the next century if temperatures were 4.5” hotter than today. For the United States, Europe, Japan, and other advanced countries, it is implausible to assume that climate change would have any significant negative effects. Transition costs, such as the building of dikes, the introduction of new crops. or the construction of irrigation facilities, may exist. For the most part, these costs are included in the estimates for Table 1. Despite those adjustment costs. most Americans would like a warmer climate.

Table 1
Annual Benefits (+) or Damages (-) from Global Warming for the United States ($ billions, 1990 dollars)

Activity	Cost - or Gain +
Agriculture	+
Forest loss	+
Species loss	- 1 . 0
Sea level rise	
Construction of dikes, levees	-0.6
Wetland loss	-1.1
Dryland loss	-0.4
Energy for heating and cooling residential homes and businesses	+12.2
Human amenities	+10.0
Human life	+40.0
Human morbidity	+37.0
Migration	+0.2
Hurricanes	-0.8
Construction	+4.4
Leisure activities	+1.0
Water supply	+5.6
Urban infrastructure	+0.2
Air pollution	
Tropospheric ozone	-2.2
[Transportation]	+0.3
[Marine Resources]	+
Total	+104.8

Source: Moore 1998a

Thomas Schelling, in his 1991 presidential address to the American Economic Association. reported that for "developed countries. the impact on economic output will be negligible and unlikely to be noticed.""" Most likely people would be oblivious of any change: they would simply enjoy the reduction in ice. snow, and cold.

Even the pessimists' estimates of the damages from global warming to both the U.S. and the world have been very small. For developed countries, these have ranged generally from 1 percent to 2 percent of GDP,[102] although Nordhaus's original estimate was for one-quarter of one percent of GDP.[103] It is generally agreed that poor countries will typically fare worse than the advanced market economies. The table below presents some of those estimates as given by the IPCC in terms of the expected loss of GDP.

Table 2

Estimates of Costs of Global Warming

Researcher and temperature increase	U.S.A.	World
Cline (4.5”) 1992	1.1%	n.e.
Nordhaus (5”) 1991	1.0%	n.e.
Frankhauser (4.5”) 1995	1.3%	1.4%
Titus (7”) 1992	2.5%	n.e.
Tol (4.5”) 1995	1.5%	1.9%
Moore (4.5”) 1998a	Gain of 1 .O%	n.e.

n.e. indicates *no estimate.*

Source: IPCC Working Group III 1995, pp. 203 & 205, and Moore 1998a.

Costs and Benefits

Let us assume that the IPCC is right and that, by the year 2100, greenhouse gas concentrations in the atmosphere will rise significantly, driving up worldwide temperatures by about 4.5” Fahrenheit. In all probability, if this warming does take place, most people will be better off. On the other hand. if we take the pessimists’ view, the costs to the United States might be as high as 1.5 percent of our GDP, although most estimates of the damage from climate change are considerably less than that figure (see Table 2). DRI estimates the cost to Americans of reducing greenhouse gas emissions to 1990 levels as 2.3 percent of GDP, a very bad benefit/cost ratio.

The IPCC’s Working Group III reviewed various estimates of GDP losses, not including DRI’s, from stabilizing emissions at 1990 levels and concluded that the average projected loss would be 1.5 percent of US GDP by the year 2050, with the costs increasing more or less linearly with time.[104] The IPCC’s forecast of a 3.6” increase in temperatures is for the end of the next century, not the middle. If we assume that the temperature will go up by only half as much over the following fifty years, from 2050 to 2100, (actually, temperatures should rise more in the second half of the century than in the first half because of lags between carbon buildup and ocean temperatures), then the cost to the United States in 2050 from warming would be, at most, only 0.75 percent. This means that using the IPCC’s own numbers, the costs of holding CO, to 1990 levels of 1.5 percent would be twice the gain from preventing any climate change!

But the benefit/cost calculus is even worse! Returning worldwide emissions, including those of the US, to 1990 levels, will *not* stabilize greenhouse gas *concentrations*. Since more CO, will be added annually for many decades to the atmosphere than the sinks can absorb, the buildup would only slow; consequently temperatures would continue to go up but by less than if no steps were taken to reduce CO, emissions. Instead, therefore, of saving the full 0.75 percent of our GDP by keeping emissions at 1990 levels, we would be saving much less. perhaps half as much or 0.375 percent of our GDP, hardly anything worth worrying about.

Of course, meeting the Kyoto protocol's goals would be more costly than simply reducing greenhouse gas emissions to 1990 levels. Having the major industrial countries of the world reduce their emissions by an overall 5 percent will not prevent climate change. Thus the costs of Kyoto are even greater than the IPCC indicated and any benefits are smaller than those that the pessimists suggest might come from eliminating climate change. Again the costs of acting greatly outweigh even the pessimists' estimates of the cost of business-as-usual.

The Chair of the Council of Economic Advisers. Janet Yellen, testified on March 4 on the costs of the Kyoto protocol. She made a valiant attempt to depict the burden of meeting the December agreement as a minor fluctuation in energy prices. After asserting the need to be conservative, she described the rosiest possible scenario on every issue. She testified that the costs of meeting the Kyoto targets might amount only to $7 to $12 billion per year! Without any of the backup analysis, it is difficult to know the source for her miraculous numbers.

Her estimates of the low cost of meeting Kyoto targets are highly dependent on trading and on what is called joint implementation. In Kyoto both these ideas were strongly resisted. The compromise eventually struck by tired delegates included approving the concepts while leaving the details to be worked out in Buenos Aires this coming fall. In theory trading would reduce costs, but it would require an international body to oversee and verify any reductions.

Since Russia and the former East Bloc countries have witnessed the collapse of their heavy, energy intensive industries and would therefore be able to claim credits, it is

usually predicted that American companies will buy their credits from those former Warsaw pact nations. No numbers currently exist, however, on how much each of these states has cut its emissions; it is assumed that the governments will come up with some estimate of CO, reductions and sell those savings. As a result, U.S. companies will be buying certificates giving them the right to emit carbon dioxide from producers who have already lowered emissions; consequently greenhouse gases will not be cut further. But American firms will be paying handsomely for those certificates.

Two Brookings Institution economists estimated that the US proposal of tradable certificates would require that US companies spend around $27 billion or more annually to purchase the rights to emit carbon from Third World or former Soviet bloc countries.“’ That sum is nearly four times the US government’s annual budget for foreign economic aid.

Dr. Yellen dismissed the Department of Energy’s report that higher energy prices would “devastate” six of our major industries, chemicals, petroleum refining, paper and allied products. iron and steel. aluminum, and cement. She argued that energy constitutes only 2.2 percent of total costs of US industry but failed to note that many industries spend much more on fuel and electricity than such trivial percentages would suggest.

The conclusion of the DOE report is worth quoting at length:

> Higher fuel costs imposed on domestic energy intensive industries uould result in an increase in production costs in these industries. The consensus of the six working groups . . . is that imports from non-participating countries would displace a significant amount of US industrial output and employment. A substantial amount of existing capacity in several of these industries would become non-competitive. Future investment in plant and equipment would be redirected from the US ... towards non-participating countries. *This conclusion is more general: all participating countries that agree to binding constraints will experience an economic decline relative to non-participating countries.* (emphasis added).[106]

In total. Janet Yellen estimated that, with trading, participation of major Third World countries, a continuation in reduction in carbon dioxide emissions per dollar of GDP, the inclusion of sinks, and somewhat higher energy prices, costs would be cut by 90 to 95 percent. Without these unlikely savings, her figures indicate that the cost would

be between 1 and 3.4 percent of GDP, She ignores the conclusion of the DOE that major industries would move abroad. Thus the administration's own numbers show that acting now would be foolish.

Conclusions

In summary, global warming will bring both benefits and drawbacks. As mentioned in *Climate of Fear: Why We Shouldn't Worry about Global Warming, I* have calculated the costs and benefits of climate change and conclude that, were the globe to warm by 4.5" Fahrenheit, the United States would, on net, gain by at least $100 billion annually or roughly 1 percent of GDP. Most Americans, probably most Europeans, the Japanese, and the Russians would be somewhat better off in a warmer world.

Small low-lying island states or countries particularly subject to sea flooding, such as Bangladesh, could experience substantial losses. As humane people, we should do our best to mitigate their problems. Providing them with dikes, levees, and infrastructure would be much more effective and also less costly for the industrialized countries than attempting to slow greenhouse gas emissions. Fostering economic policies in those countries that will enable them to deal with natural disasters is the best solution for them and for us. Rich countries can weather natural disasters — earthquakes, floods, droughts, a colder climate, or whatever problems a warmer climate may create — much more easily than poor countries. Richers is safer; warmer is better; acting now is foolish.

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Footnotes

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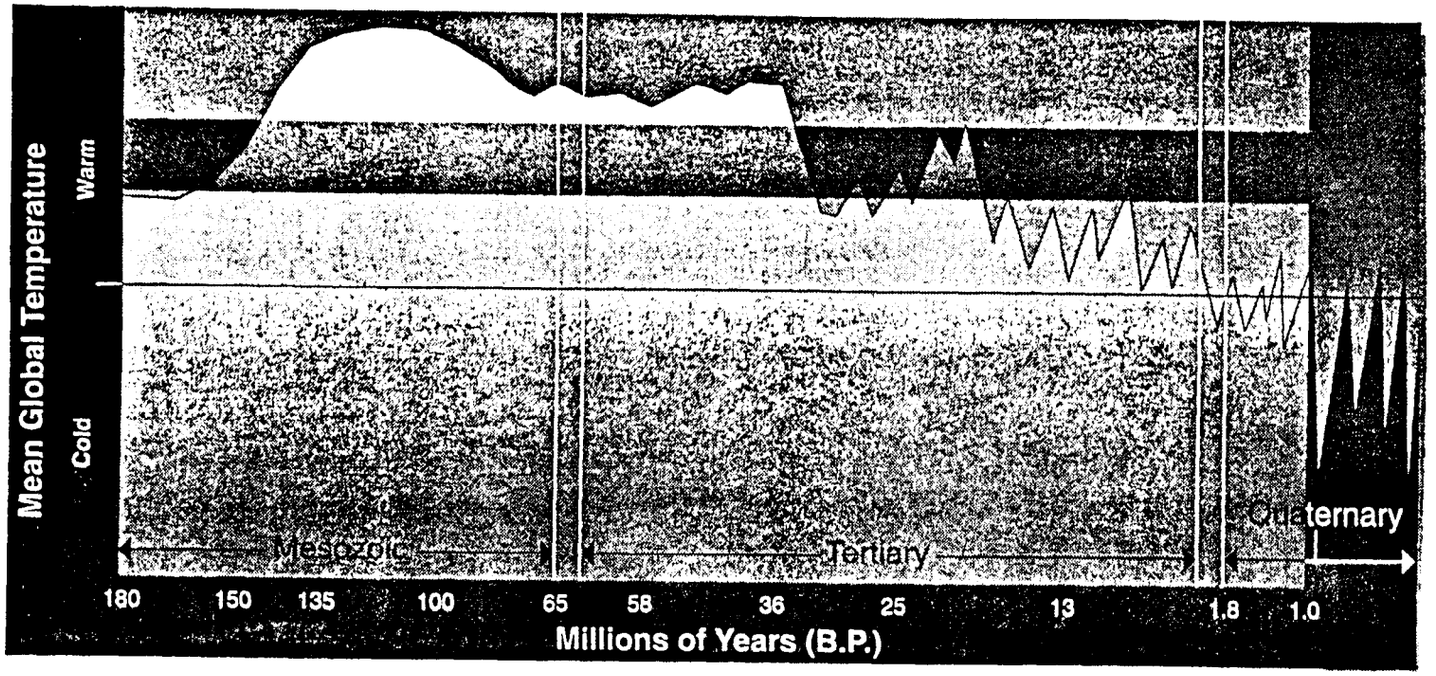

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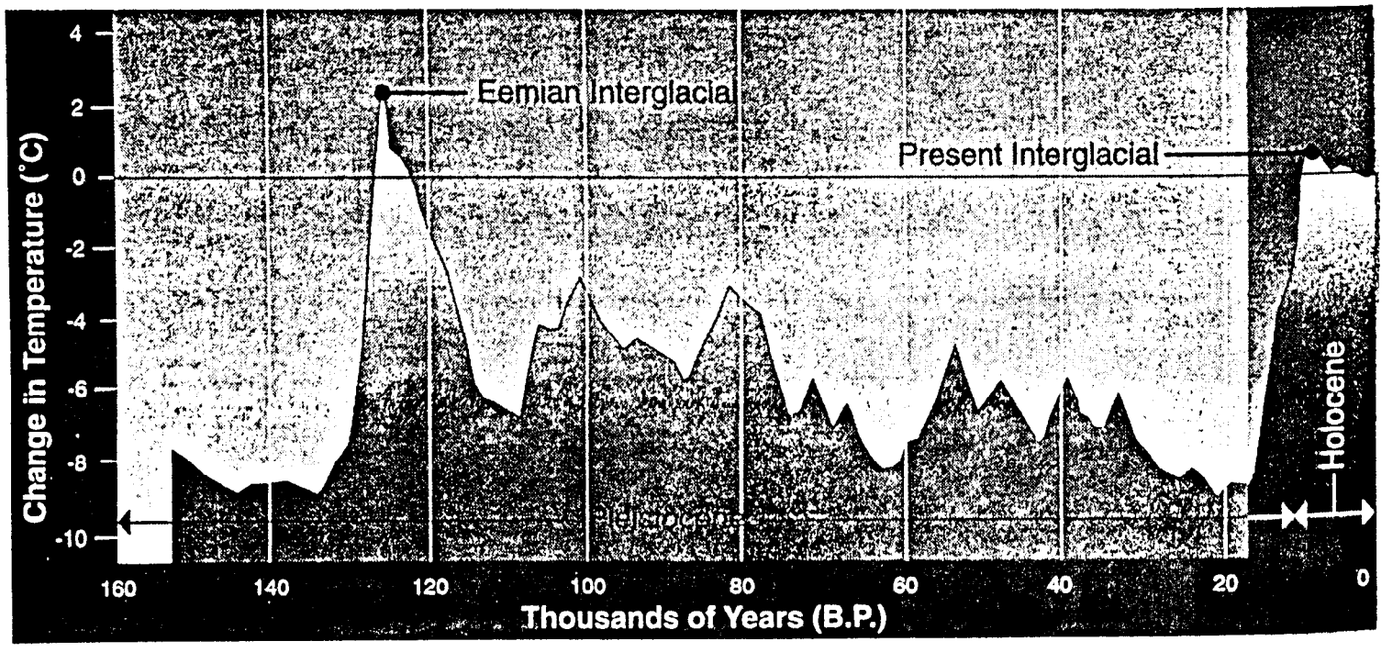

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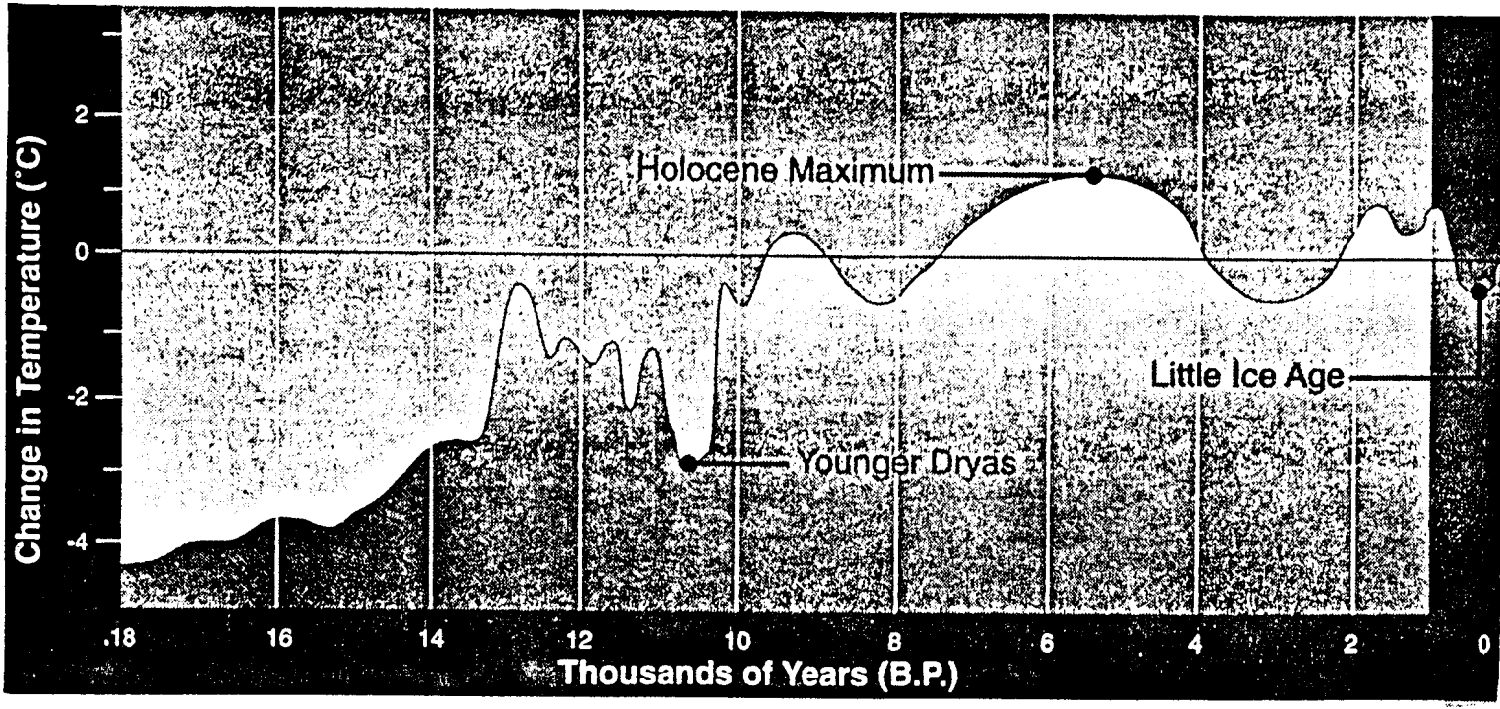

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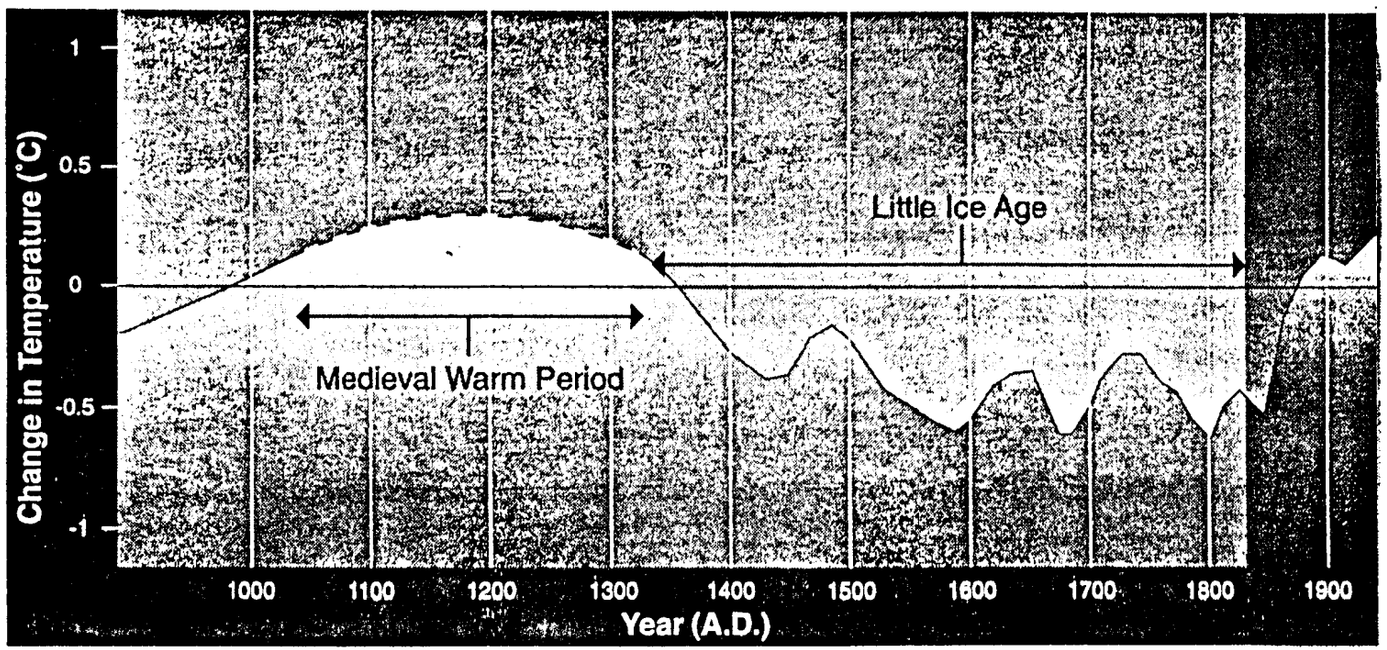

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